E-RM - Polygogo - Polygonal Synthesis - Manual

A graphical stereo oscillator with Polygonal Synthesis, originally invented at E-RM by Maximilian Rest and Christoph Hohnerlein. Based on complex two dimensional amplitude shaping of sine waves, combined with internal modulation sources and a new type of wave folder.

The main algorithmic core is carried out on a digital processor to guarantee absolute frequency stability for internal modulations. The stereo wave-overflow output is classic analog circuitry, to retain unprecedented crispness and an open sound.

Its “single knob - single function” interface, created in collaboration with instrument designer Tatsuya Takahashi, makes the Polygogo not only a terrific live performance synthesizer, but a great tool for meticulous sound design as well - no menu diving is involved.

Output X and Y

The two complex shaped sine waves are used as X and Y coordinates for plotting the figure or shape on the graphical display. These coordinates are outputted at X and Y, which can be interpreted as Left and Right to give a unique stereo effect.

Polygonal Synthesis: Parameters

Sliders, knobs and CV

Parameter	Range*	Description	Function
V/Oct	-4/+8v	1 Volt per octave	Note input, tracking 1 volt per octave.
Order	-5/+9v	Set the overtones	Adding overtones and harmonics.
Teeth	-5/+9v	Bite through the mix	Making the harmonics louder.
Roll	-3/+5v	Animate the spectrum	FM and vibrato like effects in the stereo output.
OP ratio	-5/+8v	Lin FM operator ratio	The OP frequency in relation to the fundamental.
OP amt	-4/+5v	Lin FM operator amount	Modulation depth of the FM operator.
FM in	-7/+9v	Exponential FM in	Allows for exponential modulation.
Sync	Rising	Hard Sync	Hard syncing the oscillator core.
Fold	-5/+5v	Overflow waves	Folding waves, adding harmonics and distortion.

*) Measured with a range of -10v/+10v by ear and eye (because you can on a Polygogo).

When no CV cable present, sliders are course knobs are fine tuning. When a CV cable is present, sliders are offsets and knobs are bipolar attenuators (except for v/oct).

FM in / exp in

Exponential FM input with attenuator. It tracks 1v/oct when attenuator is at about 3 o'clock. It's not 'thru zero', unlike the *OP amt*.

Sync

Hard syncs its main oscillator frequency to another (master) oscillator. When the master's oscillator frequency is higher, the Polygogo will follow that frequency. When the master's oscillator frequency is lower, you will get more sidebands and the Polygogo's *V/Oct* should be used for tracking.

Visually, when the master's frequency is higher, a 'sync reset' will not finish drawing the shape.

Fold

Fold input with attenuator. The value of *Teeth* is normalled to *Fold*, unless a cable is inserted for CV.

Buttons

Knobs	off	on	blinking
Cycle	Reset 'draw'	Continuous 'draw'	
Regular	Smooth range Order	Quantized Order	
OP ratio	Smooth OP ratio	Fixed OP ratios	Smooth OP ratio, with fixed hotspots
All three at once	Volt per octave lock. Press again to unlock. Not persistent between power cycles.		

Cycle

With the *Cycle* button, you can toggle whether the polygon is always drawn from the same spot or whether it begins drawing from the last position. This has the effect of 'spinning' the polygon and creating additional stereo movement. It creates a spatial phase shift between the X and Y outputs.

Regular

This allows the *Order* parameter to be quantized for a closed shape, resulting in less harsh overtones.

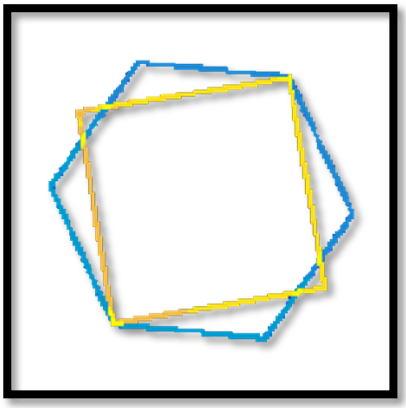
OP ratio

This sets the *OP ratio* parameter to fixed ratios or 'smooth values with fixed ratio hotspots' (blinking). Using a fixed ratio, get nice results of 'octave shifts' with low (random) values of 1:N via CV.

Polygonal Synthesis: Explained

Order

Set the overtones - Adding harmonics.

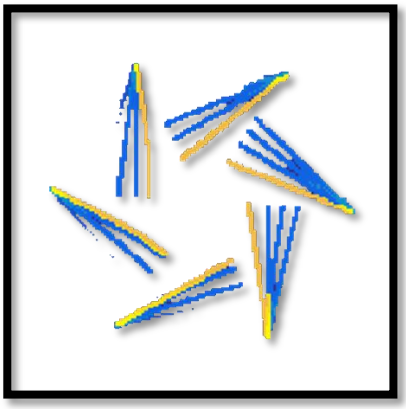


"Order defines the number of corners on the polygon, which can range from a line (order 2) to an almost perfect circle (order 28) with all fractional settings in between. The number of corners defines the ratio of overtones with respect to the fundamental frequency: a low count keeps the harmonics near the fundamental frequency, a high order shifts them up."

Adding and moving harmonics 'up and down' towards the fundamental. For a simple sine, you will see a cornered 'shark teeth' sine up until a 'perfect' showing sine.

Teeth

Bite through the mix - Making the harmonics louder.

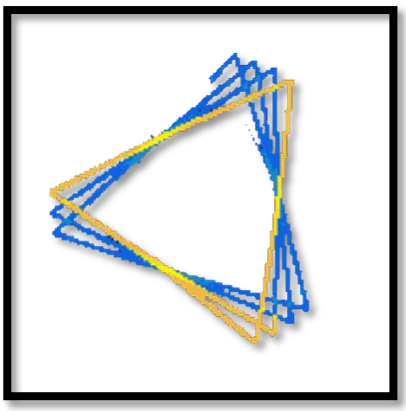


"Teeth was the first happy accident while playing with the core formula of polygonal synthesis. It tilts the sides of the polygon out of the normal orientation and can be used to control the loudness of the overtones. It creates discontinuities in the waveform and acts as balance between the fundamental frequency and the overtone spectrum."

Teeth will take the sides of the polygon and tilt them inwards creating disruptions and overtones in the waveforms resulting in louder harmonics.

Roll

Animate the spectrum - FM and vibrato like effects in the stereo output.

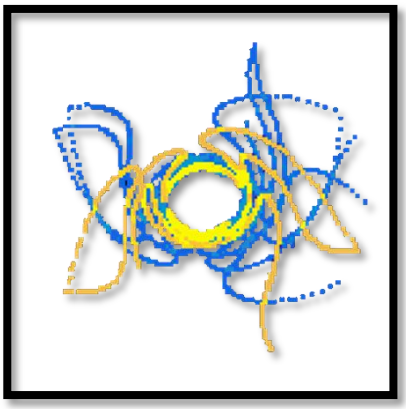


"Polygogo is a stereo oscillator. The output channels are derived directly from the X and Y pixel information, which means that both channels are slightly different most of the time. This leads to a great perception of space without any external effects. To animate the spectra of the two channels and create spatial movement, Roll rotates the object around the center and animates the waves."

Roll rotates the polygon which causes the waveforms and relative phase relationship between the X and Y outputs to constantly shift, creating spatial movement.

Operator

Modulate with precise ratios - The modulator in FM synthesis.

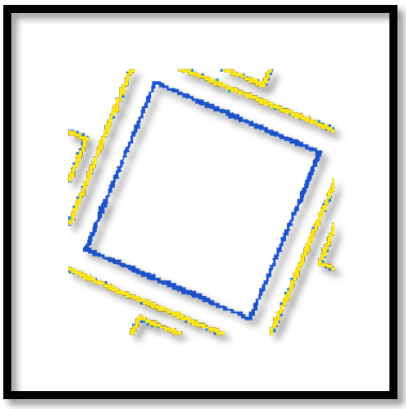


*"One of the benefits of a digital oscillator core is precise frequency tracking for **linear** FM modulation. Here, the built-in operator modulates the fundamental frequency for FM madness. FM Ratio is settable and quantizable, FM Amount goes from subtle growls in the lows to aliasing madness at high frequencies."*

Introduce FM and change the FM ratio and amount of the internal operator. You can Set *OP ratio* between smooth, fixed and 'smooth with fixed hotspot' ratios.

Fold

Overflow waves to the other side - Adding folding harmonics and distortion.



"Fold was the second happy accident while this instrument was created. Fold overflows the wave to the other side, leading to tickling noise at low settings and crushing and slicing the waveform to total distortion when fully turned up. This digital artifact was reproduced in analog circuitry and delivers the most crisp and open sound."

Push the waveform out of the edges of the screen and into the opposite side, adding harmonics at low levels and extreme crushing and distortion effects at higher levels.

Tips and Tricks

- After the module is started, press the three buttons for tuning lock. This is not persistent.
- For a (near) perfect sine; *Order* at full, all other parameters (except *v/oct*) at 0. Useful for tuning.
- Octave shifts via FM; *OP ratio button* (on) and *OP amp* set to a value. Set *OP ratio* or use with CV.
- *Fold* can be used without *Teeth* when CV is inserted. It then also breaks the normalization.
- VCA functionality could be created with *Fold* or *Teeth*. Use negative CV for *Fold* to close it.

Information taken from and thanks to:

- E-RM Polygogo [Website]
- Modwiggler - [E-RM Polygogo]
- Urogijani - [Text from SOS magazine]
- Loopop - [Polygogo review]
- Reviewers - Stice